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BOTH BRITISH CITIZENSHIP

TITLE: **CAM FOLLOWER**

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CAM FOLLOWER

TECHNICAL FIELD

This invention relates to cam followers of the type used for example in pushrod combustion engines, and to improved valve trains and engines containing the cam followers.

BACKGROUND

Cam followers, also known as lifters or tappets, are well known in combustion engines. They are used, for example, in overhead valve engines such as V-8 engines to convert the rotary motion of the camshaft into the reciprocating motion of the pushrod to activate valves.

In a reciprocating piston engine, the rotation of the camshaft is driven by the crankshaft. The camshaft and other parts of the valve train control valve timings, valve durations and valve lift. Lighter cam followers are generally desirable because a lighter reciprocating mass acting on the camshaft permits greater engine power and higher engine speeds. These benefits arise at least in part because less force is required to push the cam follower and therefore more aggressive cam shaft profiles and lighter valve biasing means can be employed.

With reference to Figure 1, a first type of known cam follower comprises a hollow cylindrical member 10 having a flat or spherical base surface 12 which in use acts as a cam engaging surface. At the other end is provided a socket 14 or similar means for cooperating with the pushrod. A problem with this type of cam follower is that it tends to be heavy.

Figure 2 shows a second type of known cam follower designed to have a lower mass. This type of cam follower is similar to the first type in that it comprises a hollow cylindrical

member 20 with a cam engaging base surface 22. However, the weight of the cam follower is reduced by providing a socket 24 for receiving the pushrod 26 within the cylindrical member 20. While this design successfully reduces the mass of the cam follower component of the drive train, the benefit is at least partially offset by the mass of the extended length of pushrod 26 required to cooperate with the socket 24.

The present invention seeks to provide an improved cam follower, valve train and engine.

SUMMARY

According to an aspect of the present invention, there is provided a cam follower having a cylindrical form, with a cam engaging surface to a base of the substantially cylindrical form and a pushrod engaging surface to the other end, the cam follower being hollow and characterised in that the substantially cylindrical form tapers towards the pushrod engaging surface such that the portion of the cam follower bearing the pushrod engaging surface is substantially conicular.

Additional advantages and novel features of the invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following and accompanying drawings or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and how the same may be carried into effect, reference will now be made by way of example only to the accompanying drawings in which:

Figure 1 is a schematic side view of a first type of known cam follower;

Figure 2 is a schematic side view of a second type of known cam follower;

Figure 3 is a cross section through an exemplary valve-in-head combustion engine embodying a cam follower according to the present invention;

Figure 4 is a cross sectional side view of a cam follower embodying the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

With reference to Figure 3, an exemplary valve-in-head engine 30 embodies the present invention. The exemplary engine 30 is of a V-8 type and has an engine block 32 housing a crankshaft 34 which is driven by pistons 36 in the well known manner of a combustion engine. The crankshaft also drives a cam shaft bearing integral cams 38 along its length. These cams 38 are arranged to actuate components of the valve train in order to operate the intake and exhaust cycles of the valves associated with each piston.

Each cam 38 engages a preferred cam follower 40 which, in turn, connects to a pushrod 42 extending between the cam follower 40 and a rocker arm 44. The rocker arm 44 is pivotably mounted such that it actuates a valve 46 against the bias of a spring 48 when the pushrod 42 moves toward the rocker arm 44 as the rotary action of the cam 38 is transferred through the cam follower 40. A skilled person will appreciate that in a V-8 engine four opposed sets of valve train components are located on either side of the cam shaft. Further, a skilled person will appreciate that many other engine designs use cam followers and pushrods in the same or a similar manner.

Figure 4 shows a cross-sectional side view of a preferred cam follower 40 embodying the present invention. In this example, the cam follower 40 is made of a pressed steel and is provided in two parts; a circular cylindrical cam engaging portion 50 having a substantially flat or spherical cam engaging surface 51 and a conicular pushrod engaging portion 52 having a pushrod engaging surface or socket 53. The two parts are made as separate items and joined by a screw thread 54. A skilled person will appreciate that the component parts may be joined by any suitable means, or, alternatively formed integrally. When combined, the cam follower 40 is substantially hollow.

The overall geometric form of the exemplary cam follower 40 is thus substantially cylindrical with a taper towards the pushrod engaging end 55. This geometric form has particular advantages in that, in use, it efficiently transfers compression forces imported to the cam follower 40 from the pushrod 42 into the walls 62 and 64 of the cam follower 40. This efficient transfer and dissipation of compression forces enables the or each component to be made with thinner walls 62 and 64, thereby saving weight without the need to extend the length of the pushrod and without the need to reinforce any other parts.

In the preferred embodiment, the angle α subtended between a tangential plane through the cylindrical side wall 62 and a corresponding plane through the tapered side wall 64 is 15 degrees plus or minus 2 degrees. The angle α may be anywhere in the range 5 to 40 degrees but is preferably in the range 10 to 20 degrees.

The length Y of the conicular pushrod engaging portion 52 along the longitudinal axis P ought to be greater than 10% of the length X of the cylindrical cam engaging portion 50 in order to efficiently transfer the compression forces incurred in use into the walls 62 of the cylindrical cam engaging portion 50. Preferably, the length Y is greater than 30% of the length X and more preferably still it is greater than 50% of the length X. The length Y of the

pushrod engaging portion 52 along the longitudinal axis P is typically between 60 and 75% of the length X of the cylindrical cam engaging portion 50.

The external base diameter Z of the cylindrical cam engaging portion 50 is typically about 25 to 35% of the length X. In one embodiment, the length Y is 68% of the length X and the diameter is 31% of the length X.

One exemplary cam follower which has been tested has dimensions X = 35mm, Y = 24mm and Z = 11mm.

A skilled person will appreciate that a cam follower embodying the invention may be made in any suitable material, such as a metal, alloy or composite, including future developed materials. Further, a skilled person will appreciate that while the foregoing has described what is considered to be the best mode and where appropriate other modes of performing the invention, the invention should not be limited to the specific configurations or method steps disclosed in this description of the preferred embodiment. Those skilled in the art will recognise that the invention has a broad range of applications and that the embodiments may take a wide range of modifications without departing from the inventive concept.

For example, the invention has applications in all manner of combustion engines, for example engines in road vehicles, specialized vehicles, ships and trains, but will have particular application where weight savings are at a premium.

The cam engaging surface 51 may take any suitable form such as a flat, sphere or roller. Further, the pushrod engaging surface or socket 53 of the cam follower 40 may be formed as a cup, ball or any other suitable pushrod engaging means.